



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE DEPRECIATION PROBLEM

BY WILLIAM B. JACKSON,

Of D. C. and William B. Jackson, Consulting Engineers, Chicago and Boston.

In considering "The Depreciation Problem" it is essential to clearly understand what the word depreciation actually represents. There is no universally accepted definition of the term, so far as the writer knows, though the importance of depreciation as a factor in the operating costs of electric railroads has been recognized by most writers on the subject of railroad finance and by the commissions having to do with railroad questions. In its more important features, in consequence, there has come to be a generally accepted consensus of opinion as to what depreciation means.

Every part of a properly constructed and well-equipped electric railway can be maintained in good operative condition by current repairs for a period of years; but the time comes with every building and unit of equipment when it, like a suit of clothes, can no longer be kept serviceable by repairs or current maintenance, and when it must consequently be replaced substantially in its entirety. It will thus be seen that two elements enter into the maintenance cost of the unit: One, the current maintenance or repair expense required to maintain it in condition suitable for service, and the other the cost of replacing or renewing it at the end of its useful life. The latter entails the necessity of accumulating, during the life of the unit, sufficient funds to replace it when it must go out of service. Expenditures for current maintenance are naturally distributed more or less uniformly throughout the life of the part, in accordance with the needs for repairs, while the expenditure made necessary by depreciation must all be met at the end of the useful life of the unit, and is, therefore, often designated as deferred maintenance. Depreciation results from this quality, found in most parts of electric railway plants, which limits their useful lives and makes their ultimate replacement, as a whole, necessary notwithstanding that current repairs may have been well attended to.

The length of useful life of a unit is determined by one, or

both, of two factors: First, the inherent quality of most physical property to deteriorate, on account of the effects of use and of the elements, to a point where it cannot be longer economically maintained in satisfactory operative condition by ordinary repairs—that is, a unit ultimately reaches a point of “decrepitude” when it is either impossible to keep it in satisfactory operative condition by current repairs, or the cost for such repairs becomes so great that it is more economical to replace the old unit by a new one. Second, the effects of changes in the art whereby the character of the service required is so changed, or the efficiency of apparatus for providing corresponding service is so improved, that a plant still physically capable of doing the work for which it was designed is no longer able to economically provide the service required, and it is, therefore, obsolete. This second factor is well designated “obsolescence.”

A third division called “inadequacy” is sometimes considered in estimating depreciation. This is intended to cover the effect upon the useful life of apparatus or plant of expansion in business whereby otherwise serviceable apparatus is outgrown and must be replaced by larger apparatus. The writer does not consider such a division necessary, for any effect caused by inadequacy which can be estimated may properly be considered under “obsolescence.”

These principles apply simply and perfectly in practice. Let us take, for example, a new electric railway and consider for a moment the rails and their fastenings. Current maintenance will keep these in good operative condition for, say, an average of seventeen years on the straight track, and for an average of five years on the curves. This will be accomplished by the usual track gangs, which will keep the track in alignment, raise low joints when they occur, replace a defective rail as occasion requires, etc. But after a period of years the track gang can no longer keep the rails so that they are safe or suitable for service, and then large sections of track must be replaced as units, for which relatively large expenditures must be made. Such expenditures cannot be provided for in the same manner as expenditures for current repairs. The latter are distributed with reasonable uniformity year by year, and may be cared for from current earnings, but the former are of only periodic occurrence, and require relatively large expenditures of accumulated funds.

These renewals cannot appropriately be paid for from funds charged to capital account, for that would have the ultimate effect of piling up unending capital with only one set of rails to show for it, nor can they appropriately be paid for by the company's notes to be liquidated during the life of the new rails, except under emergency conditions or in case the company had accumulated assets for the specific purpose of carrying such notes, for this would keep the company loaded with floating indebtedness which, when paid, would only have to be renewed when another set of rails was required. The company should accumulate funds during the life of the rails for the express purpose of providing for their replacement at the end of their useful life. The only way to be reasonably assured of having such funds when required is to estimate, when the rails go into use, the average years of service to be expected from them and the net cost of their renewal, and then distribute the charge for their replacement over the estimated useful life. And thereby the annual depreciation of the rails is obtained.

By the same process the requirements for depreciation of each kind of plant in a property may be estimated and the average amount per annum that must be appropriated to care for depreciation or replacements for each kind of plant may be determined. With possession of this information, it is merely a matter of taking the aggregate of these amounts to obtain the annual appropriation to the depreciation account required for the entire property. A knowledge of this amount places the management of an electric railway company in position to have the books of their company so organized that the accounts will show, month by month and year by year, the amount of appropriation required for depreciation and the amounts of the appropriations actually made for the purpose, together with the amount of the fund that should be in the depreciation reserve and the sum actually accumulated. They are then in a position to know, at all times, the depreciation requirements of their company and its accomplishments in providing for deferred maintenance and depreciation reserve. In the case of many electric railroads the average costs for deferred maintenance are as large, and in some cases are larger than for current maintenance, and their importance should be fully taken into account in a system of accounting that is to show the true operating costs of any property.

To estimate the correct amount of annual depreciation that should be expected in an electric railroad, the factors of "decrepitude" and "obsolescence" must each be given due weight. The effect of "decrepitude" is likely to be physically apparent in a piece of apparatus during a larger portion of its useful life than is that of "obsolescence," but the ultimate effect of either is to terminate the useful life of the apparatus. With buildings, power-plant apparatus and electrical equipment the factors of "decrepitude" and "obsolescence" are usually both active in determining the rate of depreciation. "Obsolescence" alone determines the rate of depreciation in road bed since there is no physical deterioration that cannot be made good by current repairs, and road bed is only superseded because of abandonment of old locations, owing to requirements for better alignments, lower grades, etc. Depreciation in steel rails may usually be considered as occasioned by "decrepitude," since their replacement is generally made necessary by wear alone; unless the requirements of heavier rolling stock call for the laying of heavier steel, in which case the additional cost of heavier rails may be chargeable to capital.

There is some division of opinion as to whether railroad ties may be considered as coming within the classes of property for which deferred maintenance appropriations should be made. The propriety of making such appropriations on account of ties will be most readily appreciated if considered from the viewpoint of a new property. During the earlier years of a railroad's existence there is no expense on account of ties, further than the renewal of a defective tie from time to time, but after from five to seven years tie replacements become necessary in large quantities, and excessive expenditures for deferred maintenance occur. Thus during the earlier years a misleading cost for tie maintenance will be shown unless appropriate consideration has been given deferred maintenance in the depreciation account.

The same considerations apply to almost all parts of an electric railway property. In the case of ballast the dividing line between current maintenance and deferred maintenance is likely to be less marked than with ties, but the propriety of building up a fund to extinguish the cost of ballast on roadbed which may be abandoned owing to improved alignment and gradients following the demands of business is clearly apparent.

An intelligent estimate of depreciation in a property must

depend upon a thorough knowledge of the nature of the service demanded by the different kinds of plant, a wide acquaintance with the general experience respecting like kinds of plant, a broad survey of the probable effect of local conditions upon the useful life of the plant, and a wide knowledge of the past and present progress of the art, in order that an intelligent forecast may be made of the influences of "decrepitude" and "obsolescence" upon the rate of depreciation of the plant, and the salvage values to be expected; and the estimates should be periodically revised, as time brings forth new developments to influence past conclusions.

The difficulty of arriving at a satisfactory basis for the calculation of depreciation is unfortunately not properly appreciated by the average layman, and by many students of the street railway problem. They are inclined to believe that the depreciation charge upon a large city system is the same as that upon a suburban or interurban railroad. They even overlook the fact that the constant changes in the art of electric traction necessitate continual revisions of the tentative standards adopted for any given property.

If they keep these matters in mind, however, the true significance of the problem and its importance both to the railways and the public should be understood.¹

Depreciation requires most thoughtful consideration on account of the insidious nature of its growth. When a well-designed and constructed property is new it will operate for some years without any expenditures on account of depreciation, but after a limited period apparatus becomes worn out or obsolete, and its renewal or replacement becomes necessary. Ties, which for the first few years require only the attention of the regular track gangs, become unfit for further use and must be replaced in large numbers; pole lines must be renewed in their entirety; trestles reach a condition when they must be replaced entirely, or substantially so; buildings and power plant apparatus become worn out or obsolete; cars and equipment must be replaced; old grades and alignments become inadequate, and old roadbed must be abandoned for new. In fact, depreciation must be provided against every part of the physical property except land. But the growth of depreciation or deferred maintenance expense does not necessarily become apparent in the

¹For the purpose of illustrating the nature and importance of the charges which should be made to the depreciation account, the allowances made upon three

operations of the property until the necessity of relatively large expenditures for replacements is at hand, and there is the possibility of such time arriving without those in charge of the plant realizing its approach. When such replacements become necessary they necessitate expenditures in large amounts which cannot be taken care of

important systems, as reported in the Special Census Bulletin on Electric Railways for 1907, are here reproduced.

RATES OF DEPRECIATION.²

ITEM.	ESTIMATED PER CENT OF VALUE TO BE ANNUALLY PROVIDED FOR.		
	Adopted by Chicago Union Traction Co.	Adopted by Third Avenue Railroad Co., New York. ⁴	Adopted for adjusted accounts of Milwaukee Electric Railway and Light Co.
Track and roadway:			
Track, ties, bonding, etc.....	7.75	8 to 9	7.5
Special work and installation.....	7.75		8.0
Rolling stock:			
Bodies and trucks.....	5.00	5	5.0
Electrical equipment.....	6.66 to 8.50		7.5
Fenders, registers, lights, clocks, etc.....			10.0
Overhead system:			
Poles.....	45.00		5.0
Wiring, fittings, etc.....	10.00 to 14.00		10.0
Underground system:			
Conduits.....		3	2.0
Feeders, cables, etc.....		3	4.0
Power-plant equipment:			
Engines.....	6.66	4	5.0
Boilers.....	6.66		7.5
Heaters, economizers, pumps, etc.....	6.66		7.5
Piping.....	6.66		5.0
Traveling cranes.....	6.66		5.0
Belting, shafting, ropes, etc.....	6.66		5.0
Coal and ash conveyors and hoist wagons.....	6.66		5.0
Dynamos.....	6.66		5.0
Generating apparatus.....	6.66		5.0
Storage battery.....	6.66		10.0
Switchboard and cables.....	6.66		5.0
Shop tools and machinery.....	5.00		7.5
Buildings and improvements.....	2.00	2	2.0

With a few exceptions, each percentage in the above table refers to a group of two or more parts or kinds of plant and represents the percentage obtained from the aggregate of the depreciations for each part calculated separately. The percentages therefore may not be applicable to any other particular road without modifications. This will be appreciated by referring to the items of track, ties, bonding, etc., which are all shown in one group though they do not individually have the same rate of normal depreciation, and all engines are in one group without regard to their types or quality.

² From table submitted in the case involving the rates of fare in the city of Milwaukee, Electric Railway Journal, April 10, 1909.

³ Rates quoted in the franchise-tax case.

⁴ Iron poles.

by the usual appropriations for current maintenance, and their cost may not be cared for by funds on capital account, for the replacements add nothing to the capital value of the plant except in so far as the replacements may be of a more costly character than the original, in which case the difference in cost may appropriately be charged to capital account.

Where, either through want of foresight or lack of earning capacity of the property, those having in charge the well-being of an electric railroad have not seen to it that appropriate assets have been accumulated to care for the depreciation of the plant, it means that one of three conditions will arise when the time finally arrives when the replacements on account of depreciation *must* be made: Money must be borrowed, on the strength of the future earning capacity of the road, to cover the cost of the replacements (such borrowings being gradually liquidated from the earnings of the road), while at the same time a keen eye is kept on the care of depreciation for the future; or the property may be forced into the hands of a receiver; or it may be possible to do what is indefensible under the conditions, float additional stock or bonds to take care of expenditure for renewals of plant that is already represented in capital.

Failure to appreciate the inexorable law that apparatus must come to the end of its useful life has resulted in the financing of economically unsound electric railroad enterprises, and in the embarrassment of good enterprises through the distribution to the stockholders of funds that should have been held in reserve for deferred maintenance. Difficulties arising from lack of funds with which to provide replacements are often responsible for poor service—sometimes even for unsafe service—upon roads from which good service should be expected. On the other hand, failure to anticipate all of the expenditures that must be expected when the effects of depreciation have become apparent has, in some cases, led to the establishment of rates less than sufficient to provide for all of the expenses of the properties and give a fair return on the investment.

The importance of "The Depreciation Problem" as related to electric railway properties has not been fully recognized in the past. This is probably not surprising considering the peculiar nature of depreciation, the limited degree to which its importance has been

understood, the conditions under which many railway projects have been financed in the past, and the great magnitude of many of the railroads of the country.

In the financing of early electric railroads the depreciation expenses were frequently ignored either on account of lack of understanding of the necessity for considering such expenses or because of a desire to make a creditable paper showing of projects which, if fairly presented, would be seen to be without merit; and the policy of ignoring depreciation expenses has sometimes continued after such projects were financed, owing to deficiency in funds to care for such expenses. But probably the most fruitful reason for ignoring depreciation expenses in connection with electric railways has been the influence of the example of the large and well-established steam railroads. With these it has been the usual practice not to consider depreciation expenses separately from current maintenance expenses. Such procedure has been supported on the grounds that when a railroad becomes large and well established the depreciation expenses become equalized and may be distributed with much the same uniformity as those for current maintenance. The situation is different for electric railways. These are relatively new and comparatively small, and few of them have arrived at the time when the annual expenditure required for replacements has reached its maximum. In most cases, moreover, when expenditures on account of depreciation must be made they are irregularly periodic and relatively large, and cannot easily be distributed so as to be met from day to day by the current earnings. Accumulated earnings are required for their payment.

In the past it has been a not uncommon practice to finance renewals and replacements of plant by issues of stock or bonds. This procedure was frequently sanctioned without thought of impropriety. Such a procedure, however, means the ultimate destruction of any reasonable relation between the expenditures for construction charged to capital account and the actual physical property represented by plant in service. If proper attention has been given to current maintenance and deferred maintenance, an electric railroad should be capable of giving substantially as good service after years of operation as if it were a road newly constructed for the same service. The construction cost approximately chargeable to capital account should not differ materially in the two cases except

as it might be influenced by changes in costs of material and labor between earlier and later dates.

Since funds should be in hand to replace the parts of an electric railroad at the end of their useful lives, it is evident that such funds should be accumulated gradually during the lives of the parts. The ideal plan would be to make this accumulation by uniform yearly increments. Such a procedure is frequently not practicable, owing to the variations, from year to year, in the balance of gross earnings over current operating expenses, and also from the fact that for the earlier years of operation, during the upbuilding of the business, there is likely to be little or no margin of earnings which may be devoted to such purposes, although the project may have a perfectly sound basis.

Electric railroads must expect lean years when it is difficult to meet all obligations, and prosperous years when the shortcomings of the lean years should be met. The prosperous years should provide surplus for the future if a reasonable operation of the property will permit. The building up of a depreciation reserve is likely to be affected by this condition. From this fact, coupled with the fact that expenditures for renewals are irregular in their occurrence and large in amount, it is clearly seen that this important factor in the necessary expenditures of any electric railroad can only be given suitable consideration if the books of the company show how the annual appropriations made to the depreciation fund agree with the estimated amounts that should have been appropriated, and also how the fund accumulated in the depreciation reserve agrees with the surplus that should be in hand.

It should be recognized that so long as a property is in condition to give as much and as good service as when it was new, its value, as represented by the amount of legitimate earnings to which it is entitled, cannot become reduced owing to depreciation in its plant. But any depreciation that may have occurred should be offset, when practicable, by a reserve carried for that purpose, or, if the property has been unable to make full appropriations to the depreciation account, complete knowledge of the situation should be possessed by the management, and the building up of the reserve in the future should be a most important financial consideration. Since the renewals do not occur at the same time for all parts of a property, an electric railway after beginning operation is never

equipped throughout with a new plant. Therefore there is a difference between the first cost of the depreciable plant and a depreciated value estimated for the same plant on the physical condition after years of use. The depreciation reserve need not equal the full amount of this difference.

One of the simplest ways in which the books of a company may be arranged to show the facts in relation to depreciation appropriations and reserves, is to have accounts showing the amount by which the physical property of the company is depreciating month by month, as determined by estimate made in the manner heretofore explained; showing the actual appropriations made to the depreciation fund, and showing the amounts expended for replacements on account of depreciation. Any income derived from the investment of depreciation reserve may be utilized as accretions to the reserve.

An appropriate combination of such accounts will show at all times the relation between the total amount that the property has depreciated and the amount of reserve held to care for this depreciation, as well as the relation of the actual amounts appropriated to care for deferred maintenance to the amounts expended for this purpose.

Since electric railways, and other public service companies, have in many States come under the regulative control of state commissions and municipal authorities, there has been much discussion as to whether, in the case of properties which have paid generous dividends to the security holders—the depreciation account being meanwhile permitted to languish—the security holders should be expected to build up the depreciation reserve to correct proportions from earnings that might otherwise appropriately go into their own pockets. Some findings of the United States courts and rulings of state commissions indicate a tendency toward an affirmative answer, but a difficult phase of the matter is the determination of what may be considered undue dividends for an electric railway company, especially during past years, considering the newness of the art of electric railroading and the relatively unstable state of the business during the past and in the present. Such questions as these do not affect the obligation on the part of electric railroad managements to have their accounts arranged so that they will be kept informed whether they are protecting the interests of their prop-

erties in the matter of depreciation appropriations and reserves; and, if they are not, that they may have the information to enable them to intelligently handle the problem of correcting the situation.

Even if a property is not in a position to care for depreciation as outlined in the foregoing, owing to relatively small earnings, this does not justify ignoring the facts relating to depreciation since any readjustments of rates that may be found necessary should be undertaken with full knowledge of all matters affecting the real cost of service. Commissions and others, who have given attention to the question of railroad capitalization and rates, agree that deferred maintenance costs should be met as an operating cost and not as a capital charge. Under these conditions it is essential that electric railway companies should accumulate funds from earnings which will place them in position to care for the renewals required by the effects of depreciation.

It should be borne in mind that "The Depreciation Problem" does not represent the only purpose for which funds must be accumulated during the present to care for liabilities maturing in the future. Every company must expect to meet expenditures occasioned by extraordinary occurrences which cannot well be covered by ordinary insurance, such as the effects of unusual storms and conflagrations, the results of strikes, extraordinary accidents, and the like; and every company occupying public ways is confronted with the certainty that they will be compelled to make costly changes of plant owing to changes made in state or municipal regulations. It is proper that a company should make annual appropriations to provide funds to meet obligations arising from such causes.

Where franchises are limited there is the necessity for accumulating sufficient reserve funds to protect the security holders from loss of their capital under the most unfavorable conditions that are likely to arise at the termination of the franchises. Where companies abandon valuable plants, as when they give up their own power plants to buy power from outside sources, the net value of such abandoned property should be gradually extinguished from the capital account by accumulations from earnings. Again, plans for financing electric railroad properties frequently call for accumulations of earnings according to a definite contract; and other legitimate needs for reserve or surplus funds arise.

In the foregoing consideration of "The Depreciation Problem" I have followed principles having general application to all electric railways. The question of rates charged by public service companies is far from being settled. An extensive readjustment is now taking place, and it seems inevitable that rates will be periodically revised in the future. It seems manifest, therefore, that a full understanding of all the elements which make up the cost of railroad service is necessary. An important one of these elements, and one which has heretofore failed of adequate attention is that of depreciation renewals. The renewal expenses required by depreciation should be squarely faced, and not passed on in multiplied ratio to future generations.

Correction. The word “approximately,” next to the bottom line on page 38, should read “appropriately.”